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REMARKS

By way of this amendment, claims 17 and 19 have been amended. Claims 1-19 remain present in this application. Applicant respectfully requests reconsideration and allowance of the present application.

In the Office Action, claim 17 was objected to because of a cited informality. Applicant has amended claim 17 as suggested by the Examiner to render the claim objection moot. Claim 19 has also been amended to correct a grammatical error. Additionally, Applicant has amended the specification to correct an informality in the Summary of the Invention.

Claims 1-3, 7-16, 18 and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pao et al. (U.S. Patent No. 5,931,371). Applicant respectfully traverses this rejection for the reasons presented below.

Before discussing the rejections of the claims, it is important to appreciate Applicant's invention and the advantages realized therefrom. Applicant's invention is directed to an electronic package that includes a circuit board and a surface mount device mounted on the circuit board at the interface of a contact terminal and mounting pad. The connecting solder joint includes a reflow solder material and a plurality of stand-off members that provide a separation distance between the circuit board and surface mount device within a controlled range of about 0.01 millimeters to 0.10 millimeters.

Applicant's plurality of stand-off members provide a controlled height solder joint interconnection between the surface mount device and the circuit board so as to minimize shear fatigue which may be caused by thermal expansion and vibrations. The present invention advantageously provides for an enhanced electrical and mechanical connection to achieve a reduction in strain energy of the solder joint by providing sufficient columnar solder height and limited controlled height solder joint interconnection. As a consequence, the solder joint of the present invention is less susceptible to thermal and vibratory fatigue. This allows for use of large surface mount devices on a circuit board that is less susceptible to adverse effects such as breakage caused by vibration induced fatigue.

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The Pao et al. patent discloses a stand-off controlled interconnection that employs a stand-off solder portion having a higher melting temperature than the base solder portion and a height which substantially corresponds to a specific desired stand-off height between the component and a substrate. At column 3, lines 16-18, Pao et al. specifically discloses that the size or diameter of solder ball (18) generally corresponds to the desired stand-off (20) (or height) between the component and PCB (14). At column 5, lines 9-13 Pao et al. states that the diameter of solder ball (18) may be of any diameter sufficient to achieve the desired cycle life and design parameters, and further states that the solder ball (18) should generally have a diameter in the range from 0.05 to 0.020 inches (0.127 to 0.5 millimeters). Column 3, lines 28-32 of Pao et al. further states that in order to achieve a design life of 1,000 cycles (one hour lapped thermal cycling between -55°C and 125°C), it has been demonstrated for the case of a typical 2512 LCR that stand-off (20) should be at least 0.01 inch (0.254 millimeters) to keep the total shear strain range smaller than 0.2 percent.

The teaching(s) of the Pao et al. patent is directed to controlling stand-off (20) to achieve improved reliability and durability of the solder interconnection between substrate (14) and component (24). This is clearly achieved in Pao et al. by specifically requiring a diameter in the range of 0.127 to 0.5 millimeters and, more specifically, of at least 0.254 millimeters to achieve the desired total shear strain.

In contrast, Applicant's claimed invention, as recited in claim 1, is directed to an electronic package comprising a circuit board having a substrate and circuitry, and a surface mount device having a contact terminal. A mounting pad is formed on the circuit board. The electronic package includes a solder joint connecting the contact terminal of the surface mount device to the mounting pad on the circuit board. The solder joint comprises a reflowable solder and a plurality of stand-off members disposed in the solder. In Applicant's claimed package, the plurality of stand-off members provides a separation distance between the circuit board and surface mount device in the range of about 0.01 millimeters to 0.10 millimeters. The method of claim 12 similarly recites a plurality of stand-off members each comprising a

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dimension in the range of 0.01 millimeters to 0.10 millimeters for use in forming a solder joint.

The requirements for making a *prima facie* case of obviousness are described in the *Manual of Patent Examining Procedures* (MPEP) §2143 as follows:

In order to establish a *prima facie* case of obviousness, three criteria must be met. MPEP § 706.02(j). Firstly, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. *In re Fine*, 5 USPQ2d 1596 (Fed. Cir. 1988). Secondly, there must be a reasonable expectation of success. *In re Merck & Co., Inc.*, 231 USPQ 375 (Fed. Cir. 1986). Thirdly, the prior art reference (or references) must teach or suggest all the claim limitations. *In re Royka*, 180 USPQ 580 (C.C.P.A. 1974).

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991).

MPEP §2143.01 provides further guidance as to what is necessary in showing that there was motivation known in the prior art to modify a reference teaching. Specifically, MPEP §2143.01 states:

The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ 2d 1430 (Fed. Cir. 1990).

Applicant submits that the Examiner has failed to establish a *prima facie* case of obviousness. First, the Pao et al. patent fails to teach or even suggest a solder joint comprising a plurality of stand-off members providing a separation distance between the circuit board and surface mount device in the range of about 0.01 millimeters to 0.10 millimeters, as recited in Applicant's claims. Instead, Pao et al. specifically requires solder balls (18) generally having a diameter in the range of 0.127 to 0.5 millimeters and, more specifically, requires standoff 20

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of at least 0.254 millimeters for purposes of achieving a desired total shear strain leading to a longer component/interconnection durability and cycles life.

Second, there is no suggestion or motivation in Pao et al. to employ a stand-off member that provides a separation distance in the claimed range of 0.01 millimeters to 0.10 millimeters. Instead, Pao et al. teaches away from employing solder balls (18) of the size or diameter less than 0.127 millimeters. Thus, one of ordinary skill in the art would not have been motivated to choose the claimed height as set forth in Applicant's claimed invention, when in fact Pao et al. clearly teaches that a much larger stand-off height is required.

Accordingly, Applicant has demonstrated that Applicant's independent claims 1 and 12, and the claims dependent thereon, would not have been rendered obvious to one of ordinary skill in the art at the time of the present invention in view of Pao et al., and the rejection of claims 1-3, 7-16, 18 and 19 under 35 U.S.C. §103(a) in view of Pao et al. should be withdrawn. Withdrawal of this rejection is respectfully requested.

Claims 4-6 and 17 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pao et al. as applied to claims 1 and 12 above, and further in view of either Avery et al. (U.S. Patent No. 6,340,113) or Alcoe et al. (U.S. Patent No. 6,631,078). Applicant submits that claims 4-6 and 17 should likewise be allowable for the reasons set forth above with respect to the rejection of independent claims 1 and 12. Applicant further submits that neither of the Avery et al. and Alcoe et al. patent teaches or even suggests a solder joint for an electronic package employing a plurality of stand-off members providing a separation distance between the circuit board and surface mount device in the range of about 0.01 millimeters to 0.10 millimeters as recited in independent claims 1 and 12.

By way of the foregoing remarks, Applicant has demonstrated that claims 1-19 would not have been rendered obvious in view of Pao et al. alone or further in combination with either of Avery et al. and Alcoe et al., and the rejection of claims 1-19 under 35 U.S.C. §103(a) should therefore be withdrawn, which action is respectfully solicited.

Applicant is submitting herewith an Information Disclosure Statement disclosing U.S. Patent No. 4,731,130 for consideration by the Examiner. The cited reference discloses a

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solder connection with a stand-off spacing similar to the solder connection disclosed in Pao et al.

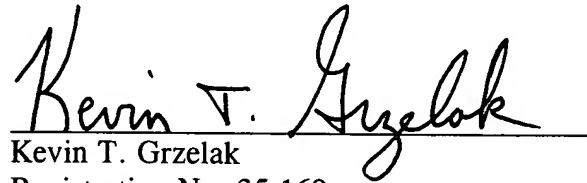
In view of the above remarks, it is submitted that claims 1-19 define patentable subject matter and are in condition for allowance, which action is respectfully solicited. If the Examiner has any questions regarding patentability of these claims, the Examiner is encouraged to contact Applicant's undersigned attorney to discuss the same.

Respectfully submitted,

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